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Research Article

Environmental Health Study: analysis of linking water clean access and sanitation levels with public health

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Abstract

Access to clean water and adequate sanitation is essential for public health and environmental sustainability. This study analyzes the relationship between water access, sanitation levels, and public health in Tanjung Karang Pusat, Tanjung Karang Timur, and Tanjung Karang Barat. Using a cross-sectional approach, data were collected through field observations, interviews, and questionnaires from 70 households. The findings indicate that 59% of households have safe drinking water access, while 7% still rely on unprotected sources and 4% have limited access to piped networks. In terms of sanitation, 34% of households have safe sanitation, while 56% have basic but self-sufficient access without regular desludging. However, 4% use shared toilets, 4% have direct waste disposal into the environment, and 1% still practice open defecation (BABS), posing serious health and environmental risks. The study highlights the disparities between urban and rural areas, where inadequate sanitation and limited water access increase the risk of waterborne diseases, economic losses, and environmental degradation. Addressing these challenges requires infrastructure improvements, public awareness campaigns, and policy interventions to ensure universal access to clean water and proper sanitation. Investment in sanitation and hygiene infrastructure is crucial to reducing disease burden, enhancing productivity, and supporting Sustainable Development Goal (SDG 6) on clean water and sanitation.

Keywoards: *Clean Water Access, Sanitation, Public Health, SDG 6, Environmental Health*

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INTRODUCTION

Humans and the environment are closely interconnected, with the right to a healthy environment recognized as a fundamental human right. The sustainable and equitable management of natural resources, including clean water and sanitation, is essential for economic growth, poverty reduction, and narrowing social disparities [1], [2]. The Sustainable Development Goals (SDGs), particularly SDG 6, aim to enhance access to safe drinking water and adequate sanitation services to support public health. Indonesia is committed to achieving this goal through various policies, positioning clean water and sanitation as key factors in promoting well-being and sustainable development. Access to clean water and adequate sanitation plays a crucial role in public health. WHO (2019) reported that approximately 829,000 deaths worldwide each year are caused by diarrheal diseases resulting from unsafe drinking water, poor sanitation, and inadequate hygiene [1]. Limited access to clean water is also linked to a higher risk of infectious diseases, including acute respiratory infections and skin diseases. Investing in clean water and proper sanitation infrastructure can reduce the incidence of diarrheal diseases by up to 60% [3] significantly improving overall public health [4], [5], [6], [7].

In Indonesia, particularly in Lampung Province, data indicates that access to safe drinking water remains relatively low compared to the national average. In 2018, the province's access to safe drinking water was only 56.78%, significantly below the national average of 73.68% [8]. Moreover, there is a substantial disparity between urban and rural areas, with 72.08% of urban residents having access to clean water, while rural areas remain below 50%. Similarly, access to adequate sanitation in Lampung Province reached only 52.48%, which is lower than the national average of 69.27% [9], [10]. Socioeconomic factors, infrastructure, and the level of public education [11] Significantly influence access to clean water and adequate sanitation in both urban and rural areas. Community-based education programs, such as the Total Sanitation Program, have successfully raised awareness and encouraged residents to adopt better sanitation practices [11], [12], [13]. A shift in mindset towards sanitation, as well as the promotion of clean and healthy living behaviors to prevent the spread of diseases such as diarrhea, thereby contributing to the overall improvement of public health [14], [15], [16], [17].

As the capital of Lampung Province, Bandar Lampung City plays a strategic role as a center for economic, social, and governmental activities. However, challenges related to access to clean water and proper sanitation remain significant issues for the community [18]. Inequality in the availability of safe drinking water sources and adequate sanitation facilities persists in several areas, particularly in Tanjung Karang Pusat, Tanjung Karang Timur, and Tanjung Karang Barat Districts. This situation negatively impacts public health, increasing the risk of environmentally related diseases such as diarrhea and acute respiratory infections due to substandard water quality. The sustainability of clean water and sanitation services largely depends on active community participation in their management and responsible usage. Raising public awareness and involvement in maintaining water quality and environmental hygiene can enhance the effectiveness of sanitation services and reduce the potential spread of diseases. In addition to adequate infrastructure, water quality monitoring must be strengthened to prevent health risks associated with contaminated drinking water. A holistic approach, combining infrastructure improvements, public education, and sustainable water resource management policies, is essential to ensuring more equitable access to clean water and sanitation, ultimately supporting public health and overall well-being.

Efforts to improve access to clean water and adequate sanitation are integral to achieving the Sustainable Development Goals (SDGs) [19] particularly in terms of public health and environmental sustainability. The disparity in the availability of safe drinking water sources and proper sanitation facilities [20]. across various regions, especially in several districts of Bandar Lampung City, highlights the need for data-driven evaluation to understand the factors influencing access to these essential services and their impact on public health. Field assessments play a crucial role in measuring progress on clean water and sanitation indicators, identifying existing challenges, and formulating more effective solutions. Therefore, this study aims to analyze the relationship between access to clean water, sanitation levels, and public health conditions in Bandar Lampung City, providing a more comprehensive understanding of their interconnection. The findings of this research are expected to generate evidence-based insights to support policy development aimed at improving water and sanitation services, fostering sustainable development, and enhancing the overall quality of life for the community.

METHODS

This study employs a cross-sectional design, where data is collected at a single point in time to analyze the relationship between access to clean water, adequate sanitation, and public health in Tanjung Karang Pusat, Tanjung Karang Timur, and Tanjung Karang Barat Districts, Bandar Lampung City. This approach allows for a comprehensive identification of factors influencing the availability and utilization of clean water and sanitation, as well as their impact on public health.

1. Research Location and Period
   The study is conducted in Tanjung Karang Pusat, Tanjung Karang Timur, and Tanjung Karang Barat Districts, Bandar Lampung City, selected based on varying conditions of clean water access and sanitation, as well as a relatively high population density. The research takes place in September 2022.
2. Population and Sample
   The population comprises all households in Tanjung Karang Pusat, Tanjung Karang Timur, and Tanjung Karang Barat Districts, Bandar Lampung City. A random sampling technique is applied to select 70 respondents, based on the following criteria:
   - Aged at least 17 years,
   - Residing in the research area for at least 5 years,
   - Having knowledge about their household's water sources and sanitation facilities.
3. Research Variables
   - Independent Variable: Access to clean water and adequate sanitation, including water sources, water treatment methods, sanitation facilities, and hygiene practices.
   - Dependent Variable: Public health, measured through occurrences of environmentally related diseases such as diarrhea, acute respiratory infections (ARI), and skin diseases.
   - Control Variables: Socioeconomic factors, education level, and population density.
4. Data Collection Techniques
   - Field Observation: Assessing household access to clean water and sanitation; Verifying water sources and domestic wastewater disposal systems.
   - Interviews and Questionnaires: Structured questionnaires are administered to respondents to gather data on water sources, water usage habits, sanitation conditions, and disease history related to water and sanitation quality.

- Secondary Data Collection: Data is obtained from the Central Bureau of Statistics (BPS), Health Department, and government reports on clean water and sanitation access in Tanjung Karang Pusat, Tanjung Karang Timur, and Tanjung Karang Barat Districts, Bandar Lampung City.

RESULT AND DISCUSSIONS

The study was conducted in three districts: Tanjung Karang Pusat, Tanjung Karang Timur, and Tanjung Karang Barat. The research locations are presented in Figures 1-3 as follows.

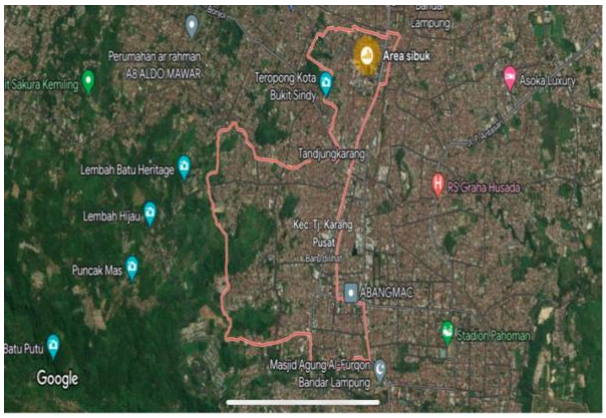

Figure 1. Kecamatan Tanjung Karang Pusat

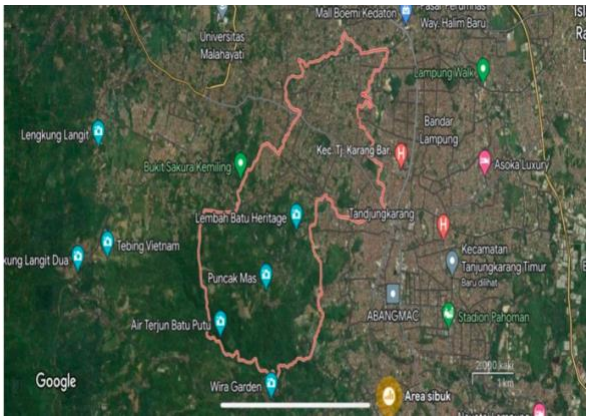

Figure 2. Kecamatan Tanjung Karang Timur

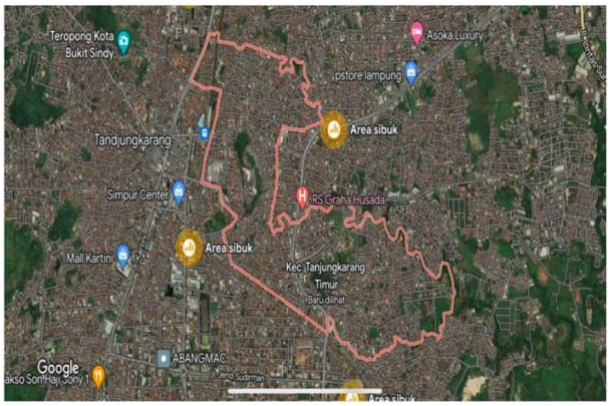

Figure 3. Kecamatan Tanjung Karang Barat

Access to adequate sanitation is essential for public health and environmental sustainability, as poor sanitation increases the risk of waterborne diseases such as diarrhea and cholera (WHO, 2019). This study in Tanjung Karang Pusat, Tanjung Karang Timur, and Tanjung Karang Barat assesses household sanitation access, categorizing facilities from safe access to open defecation (BABS) to identify areas needing sanitation improvements and infrastructure investments. The research data on access to clean water and proper sanitation at the study location is presented in Table 1 and Table 2 as follows.

Table 1. Household Drinking Water Access Classification

No	Indicator	Number of Households	Percentage	Category
1	Households using surface water sources (rivers, lakes, reservoirs, ponds, irrigation) directly without treatment.	0	0%	No access available
2	Households using drinking water from unprotected wells/rainwater storage.	5	7%	Not suitable Access
3	Households using drinking water from protected springs/wells or bore wells/pumps with collection time under 30 minutes.	21	30%	Basic suitable access
4	Households using drinking water from piped networks/pumps.	3	4%	Limited suitable access
5	Households using bottled drinking water.	41	59%	Safe access

Table 2. Classification of Household Sanitation Access

No	Indicator	Number of Households	Percentage	Category
1	Households with their own toilet, upper part with goose-neck toilet, lower part with septic tank, and desludged at least once every 5 years.	24	34%	Safe access
2	Households with their own toilet, upper part with goose-neck toilet, lower part with septic tank.	39	56%	Self-sufficient suitable access
3	ouseholds sharing a toilet with other residents, upper part with goose-neck toilet, lower part with septic tank.	3	4%	Shared suitable access
4	Households with a toilet where the lower part is directly connected to fields/lakes/ponds/rivers/beaches.	3	4%	Not suitable access
5	Households without a toilet and practicing open defecation in fields, gardens, beaches, open land, or ponds.	1	1%	Open defecation (BABS)

Access to adequate sanitation is a key indicator in achieving SDG 6, which aims to improve clean water and sanitation services. Poor sanitation can lead to environmental pollution and increase the risk of waterborne diseases such as diarrhea and cholera (WHO, 2019). Susenas (2017) data shows that 69.3% of households in Indonesia have access to adequate sanitation, but there remains a significant gap between urban and rural areas. A study conducted in Tanjung Karang Pusat, Tanjung Karang Timur, and Tanjung Karang Barat classifies household sanitation access as follows:

1. Safe Access Category : Households with their own toilet, upper part with a goose-neck toilet, lower part with a septic tank, and desludged at least once every 5 years
2. Self-sufficient suitable access category : Households with their own toilet, upper part with a goose-neck toilet, lower part with a septic tank
3. Shared suitable access category : Shared toilet with other residents, upper part with a goose-neck toilet, lower part with a septic tank
4. Limited access category : Shared toilet with other residents, upper part with a goose-neck toilet, lower part with a pit latrine/cemplung
5. Not Suitable Access Category : Households with a toilet, but the lower part is directly connected to ponds, fields, rivers, lakes, the sea, or the ground
6. Open Defecation (BABS) Category : Households without a toilet, practicing open defecation in fields, gardens, beaches, open land, or lakes

The study findings indicate an improvement in sanitation access in Tanjung Karang Pusat, Tanjung Karang Timur, and Tanjung Karang Barat, but there remains a disparity in the quality of sanitation facilities. 34% of households have safe sanitation access, meaning they have a private toilet with a goose-neck closet, a septic tank, and desludging at least once every five years. Meanwhile, 56% of households have self-sufficient suitable access, with a private toilet and septic tank but without regular desludging.

Although the majority of households have adequate sanitation facilities, 4% still use shared toilets, increasing the risk of poor hygiene. Additionally, 4% of households still have toilets with direct disposal into the environment, such as fields, ponds, or rivers, which are classified as inadequate access and may pollute water sources and spread waterborne diseases like diarrhea and cholera. 1% of households still practice open defecation (BABS), indicating a lack of proper sanitation facilities, which can contribute to the spread of infectious diseases.

These findings align with the UNICEF-WHO (2017) report, which revealed that 2.3 billion people worldwide still practice open defecation or use toilets that do not meet health standards. Additionally, WHO (2019) reported that poor sanitation contributes to approximately 432,000 deaths from diarrhea annually, particularly in areas with inadequate sanitation infrastructure [21], [22]. Inadequate household sanitation is closely linked to diarrheal morbidity, with a higher prevalence observed in urban areas compared to rural regions [23]. Limited access to clean water and proper sanitation remains a significant risk factor for various diseases, particularly diarrhea [21]. The absence of adequate waste disposal systems increases exposure to fecal contamination, further exacerbating the spread of waterborne pathogens. Studies have shown that poor sanitation conditions contribute to recurrent diarrheal infections, leading to malnutrition, stunted growth, and weakened immune function, especially in children under five [24]. Enhancing access to improved sanitation facilities, along with proper hygiene education, plays a crucial role in reducing diarrheal incidence and improving public health outcomes. Investments in sanitation infrastructure and

community-based interventions are essential to breaking the cycle of disease transmission and ensuring long-term health benefits, particularly for vulnerable populations.

Disparities in sanitation access can increase the risk of waterborne diseases. improving sanitation access could reduce diarrhea cases by 30%, one of the leading causes of child mortality in developing countries. Additionally, inadequate sanitation infrastructure can contaminate groundwater sources, further affecting drinking water quality. From an economic perspective, poor sanitation can hinder development due to rising healthcare costs and decreased productivity. World Bank (2021) reported that countries with inadequate sanitation lose up to 2-3% of their GDP due to higher medical expenses and lost productivity caused by sanitation-related diseases [25].

CONCLUSION

The study findings indicate disparities in access to clean water and proper sanitation in Tanjung Karang Pusat, Tanjung Karang Timur, and Tanjung Karang Barat. While most households have safe and self-sufficient sanitation access, some still rely on shared or inadequate facilities, with a small percentage still practicing open defecation (BABS). These conditions contribute to increased public health risks, particularly the spread of waterborne diseases such as diarrhea and gastrointestinal infections. Sanitation disparities are further evident in national and regional comparisons, where urban sanitation access tends to be better than in rural areas. This highlights the need for targeted interventions, including infrastructure improvements, hygiene education, and increased community participation. Poor sanitation also has significant economic implications, leading to higher healthcare costs and reduced productivity, ultimately hindering economic growth and social well-being.

In terms of clean water access, the majority of households in the study area have safe drinking water access (59%), yet 7% still rely on unprotected water sources, and 4% have limited access to piped water. For sanitation, 34% of households have safe sanitation access, while 56% have self-sufficient access without regular desludging. However, 4% use shared toilets, 4% have direct disposal into the environment, and 1% still practice open defecation, posing risks to public health and environmental pollution. Findings underscore that disparities in clean water and sanitation access remain a challenge, particularly in areas with underdeveloped infrastructure. Therefore, a holistic approach is required, integrating infrastructure strengthening, hygiene education, and policy reforms that promote clean water and sanitation access for all. Investing in sanitation and clean water improvements will not only enhance public health and environmental sustainability but also support economic growth and the achievement of Sustainable Development Goal (SDG 6) for universal access to clean water and sanitation.

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